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REC'D 18 APR 2006

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT  
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 16345-WO-03	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IL2004/001106	International filing date (day/month/year) 06.12.2004	Priority date (day/month/year) 29.12.2003
International Patent Classification (IPC) or both national classification and IPC INV. G01F23/284 F23G5/50 F23G5/24		
Applicant E.E.R. ENVIRONMENTAL ENERGY RESOURCES (ISRAEL) LTD		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
  - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 10 sheets.

3. This report contains indications relating to the following items:
  - I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

Date of submission of the demand  26.10.2005	Date of completion of this report  07.04.2006
Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 TX: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  Boerrigter, H  Telephone No. +31 70 340-3648  

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL2004/001106

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

### Description, Pages

1, 2, 4-34 as originally filed  
3, 3a filed with telefax on 26.10.2005

### Claims, Numbers

1-27 filed with telefax on 26.10.2005

### Drawings, Sheets

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/IL2004/001106

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-27
	No: Claims	
Inventive step (IS)	Yes: Claims	1-27
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-27
	No: Claims	

2. Citations and explanations

**see separate sheet**

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following document:

**D1:** (a) PATENT ABSTRACTS OF JAPAN vol. 1999, no. 02, 26 February 1999  
(1999-02-26)

(b) JP 10 307053 A (ISHIKAWAJIMA HARIMA HEAVY IND CO LTD), 17 November 1998 (1998-11-17)

**1 CLAIMS 1 - 13**

1.1 The document **D1** is regarded as being the closest prior art to the subject-matter of **claim 1**, and shows (the references in parentheses applying to this document, see figures 1-7 of **D1(b)**):

*A microwave transceiver unit (9a, 9b), for detecting the level of waste in a storage tank, said microwave transceiver unit comprising:  
an elongate body (2) having a configuration adapted for mounting in an aperture provided in a wall of said tank,  
said elongate body comprising microwave transmission / receiving means associated with said first end and operatively connectable to any one of a microwave generating means and microwave detection means.*

1.2 The subject-matter of **claim 1** differs from this known microwave transceiver unit in that the microwave transceiver unit comprises a metallic wave conductor coupled at its first end to said transmission/receiving means and the second end of said conductor being operatively connected to either said microwave generating means or said microwave detection means, and in that the microwave transceiver unit comprises an insulation layer substantially surrounding at least said conductor, and an outermetallic layer substantially surrounding said insulation layer.

The subject-matter of **claim 1** is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as *how to*

*determine the level of waste inside a feeding conduit that is inside of the chamber of the furnace.*

The solution to this problem proposed in **claim 1** of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: The use of a metallic wave conductor has not been disclosed by the prior art, nor has the use thereof been hinted at. Its' use is therefore inventive.

1.3 **Claims 2 - 13** are dependent on **claim 1** and as such also meet the requirements of the PCT with respect to novelty and inventive step.

## **2 CLAIMS 14 - 27**

2.1 Document **D1** discloses (see figures 1-7 and page 2, paragraphs 4-6 of **D1(b)**):

*A method for suitable for monitoring the level of waste in a shaft furnace, comprising:*

*(a) Providing one or more pairs of microwave transceiver units, wherein:*

*- the elongate body of each microwave transceiver unit is inserted through and mounted in an aperture provided in the wall of said vertical chamber; and*

*- the second microwave transmission/receiving means of each of said pairs is positioned substantially diametrically opposed to the first transmission/receiving means of the pair;*

*(b) transmitting suitable microwave radiation via one of said first or second microwave transmission/receiving means and receiving a received radiation with the other one of said first or second microwave transmission/receiving means; and*

*(c) comparing the intensity of the received radiation with the transmitted radiation to determine the level of waste in said feeding conduit by relating said comparison of intensities to a threshold value.*

2.2 The subject-matter of **claim 14** differs from this known method in that the microwave transceiver units which are supplied are those as described in **claim 1**, and as such new and inventive. Furthermore, the first end of said elongate body extends into said vertical chamber from said aperture at least into proximity with, but not in contact with a first screen transparent to microwave radiation, which is not the case in the prior art.

The subject-matter of **claim 14** is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as *how to determine the level of waste inside a feeding conduit that is inside of the chamber of the furnace.*

The solution to this problem proposed in **claim 14** of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: *A method of using microwave transceiver units with metallic wave conductors (as described in **claim 1**) has not been disclosed by the prior art, nor has this method been hinted at. The method of using these microwave transceiver units with metallic wave conductors is therefore inventive.*

2.3 **Claims 15 - 27** are dependent on **claim 14** and as such also meet the requirements of the PCT with respect to novelty and inventive step.

16345-WO-03

35

**Claims: -**

1. A microwave transceiver unit for detecting the level of waste in a feeding conduit that extends into the vertical chamber of a shaft furnace said microwave transceiver unit comprising:-

an elongate body having a configuration adapted for inserting through and reversibly mounting in an aperture provided in the wall of said vertical chamber,

said elongate body comprising microwave transmission/receiving means associated with its first end and operatively connectable to either microwave generating means or microwave detection means;

characterized in that said microwave transceiver unit comprises:

- a metallic wave conductor coupled at its first end to said transmission/receiving means and the second end of said conductor being operatively connectable to either said microwave generating means or said microwave detection means;
- an insulation layer substantially surrounding at least said conductor;  
and
- an outer metallic layer substantially surrounding said insulation layer.

16345-WO-03

36

2. A microwave transceiver unit as claimed in claim 1, wherein the microwave transmission/receiving means comprises an antenna operatively connected to the wave conductor.
3. A microwave transceiver unit as claimed in claim 2, wherein the antenna is substantially frusto-conical having the larger end thereof as a transmitting/receiving face.
4. A microwave transceiver unit as claimed in claim 2, wherein the wave conductor and the antenna are integrally joined.
5. microwave transceiver unit as claimed in claim 2, wherein the wave conductor and the antenna are made from any suitable metal including any one of stainless steel, copper and brass or alloys thereof.
6. A microwave transceiver unit as claimed in claim 3, comprising a screen means covering the transmission/receiving face of the antenna, said screen means being substantially transparent to microwave electromagnetic radiation.
7. A microwave transceiver unit as claimed in claim 6, wherein the screen means are made from any suitable dielectric material.



16345-WO-08

37

8. A microwave transceiver unit as claimed in claim 1, wherein the insulation layer is substantially tubular.
9. A microwave transceiver unit as claimed in claim 1, wherein the outer metallic layer is made from steel.
10. A microwave transceiver unit as claimed in claim 1 wherein the elongate body has a substantially cylindrical external profile.
11. A microwave transceiver unit as claimed in claim 1, comprising a sleeve member having:  
an external configuration adapted for sealingly mounting said sleeve in the aperture in the wall of the vertical chamber; and  
an internal configuration adapted for reversibly accommodating the body sealingly with respect thereto.
12. A microwave transceiver unit as claimed in claim 11, wherein the sleeve member and the body each comprise suitable flanges which are mutually facing when said sleeve member and said body are mounted together.
13. A microwave transceiver unit as claimed in claim 12, comprising a suitable sealing gasket adapted for accommodation between the

16345-WO-03

38

mutually facing flanges for sealing the sleeve member with respect to the body.

14.A method for monitoring the level of waste in a feeding conduit that extends into the vertical chamber of a shaft furnace, comprising:

(a) Providing one or more pairs of microwave transceiver units according to claim 1, wherein:

- the elongate body of each microwave transceiver unit is inserted through and reversibly mounted in an aperture provided in the wall of said vertical chamber;
- said elongate body has an axial dimension such that the first end of said body extends into said vertical chamber from said aperture at least into proximity with, but not in contact with a first screen transparent to microwave radiation, which is mounted over a suitable portal provided in the wall of said feeding conduit;
- during operation of said microwave transceiver unit, at least a portion of said first screen is in aligned relationship with the microwave transmission/receiving means of each of said microwave transceiver units and wherein said first screen is sufficiently large to maintain an aligned relationship between at least a portion of said first screen with respect to said

16345-WO-03

39

microwave transmission/receiving means for a range of displacements of said first screen with respect to said microwave transmission/receiving means; and

- the second microwave transmission/receiving means of each of said pairs is positioned substantially diametrically opposed to the first transmission/receiving means of the pair;

(b) transmitting suitable microwave radiation via one of said first or second microwave transmission/receiving means and receiving a received radiation with the other one of said first or second microwave transmission/receiving means; and

(c) comparing the intensity of the received radiation with the transmitted radiation to determine the level of waste in said feeding conduit by relating said comparison of intensities to a threshold value.

15.A method for monitoring waste as claimed in claim 14, comprising more than one pair of microwave transceiver units, wherein each of said pairs is located at a different height along the depth of the conduit.

16.A method for monitoring waste as claimed in claim 14, comprising more than one pair of microwave transceiver units, wherein each of said pairs is located at a different angular disposition with respect to a longitudinal axis of the conduit.

16345-WO-03

40

17.A method for monitoring waste as claimed in claim 16, wherein adjacent pairs are arranged in orthogonal relationship with respect to a longitudinal axis of the conduit.

18.A method as claimed in claim 14, wherein the range of displacements is correlated to the thermal expansion of the wall of the feeding conduit with respect to the wall of the vertical chamber.

19.A method as claimed in claim 14, wherein the body is distanced from the first screen means sufficiently to permit displacement of said first screen means with respect to the microwave transmission/receiving means.

20.A method as claimed in claim 14, wherein the body comprises displacement means in abutting contact with one of the wall of the feeding conduit and the first screen means to permit displacement of said first screen means with respect to the microwave transmission/receiving means.

21.A method as claimed in claim 20, wherein the displacement means comprises at least one wheel mounted for rotation with respect to the body, wherein said wheel is in rotatable contact with at least one of the wall of the feeding conduit and the first screen means.

22.A method as claimed in claim 21, comprising at least one suitable rail on at least one of the wall of the feeding conduit and the first screen means corresponding to the at least one wheel, wherein during operation of the transceiver unit, said at least one wheel is in rotatable contact with a corresponding said rail.

23.The method of claim 14, wherein only a first pair of microwave transceiver units is provided and when the intensity of the received radiation is below a predetermined threshold value it is determined that the level of waste is substantially below the level of said first pair.

24.The method of 14, wherein only a first pair of microwave transceiver units is provided and when the intensity of the received radiation is at or above a predetermined threshold value it is determined that the level of waste is substantially at or above the level of said first pair.

25.The method of claim 14, wherein a second pair of microwave transceiver units is provided at a location longitudinally displaced from the first pair of microwave transceiver units, and wherein a waste flow rate in the furnace is determined by determining the

time interval between the point at which it is determined that one of said pairs of microwave transceiver units is no longer detecting waste and the point at which the other pair of said microwave transceiver units is no longer detecting waste thereat.

26. The method of claim 14, wherein the threshold value may be controlled as desired.

27. The method of claim 26, wherein the threshold value is adjusted according to the general composition of the waste being introduced into the furnace.

16345-WO-03

3

conduit would be difficult to maintain and replace, typically requiring dismantling of the upper part of the chamber and/or the feeding mechanism. Furthermore, the thermal expansion of the feed tube with respect to the ceramic lining of the chamber also presents a problem in that the electrical connection between such detectors mounted to the conduit and the outside of the chamber needs to be expandable. On the other hand, prior art detectors that are mounted on the outside of the processing chamber would not be able to detect the level of waste within the conduit itself.

A microwave transmitter receiver arrangement for detecting the level of waste is generally known from JP 10307053 and JP 20310554. Other prior art publications, such as US 3,456,715, US 6,310,574, US 5,703,289, US 5,507,181, US 4,566,321, and JP 57029913 relate to various level monitoring systems which are boltable to a casing which contains the material whose level is to be monitored. US 3,456,715 relates to an ultrasonic-based system for detecting the level of melt in a solidification water cooled collar. Ultrasonic based systems, however, are generally unsuitable for height detection in such processing chambers because of the influence of the ultrasonic background signals generated by the processes inside the chamber.

International Patent Application WO 03/078897 by the same applicant describes a control system for a waste processing apparatus. The control

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system is designed to control the feeding of waste based on measurements of the level of waste within the apparatus.

None of these documents is directed to providing a solution to the problem of monitoring the height of waste in a high temperature environment within a